An Analysis of Siting Opportunities for CSP Plants in the Southwestern U.S.

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Presentation Outline

- Southwest GIS Screening Analysis
- Southwest Market and Transmission Overview
- Southwest Solar Power Plant Siting Assessment
- Next Steps
- Summary

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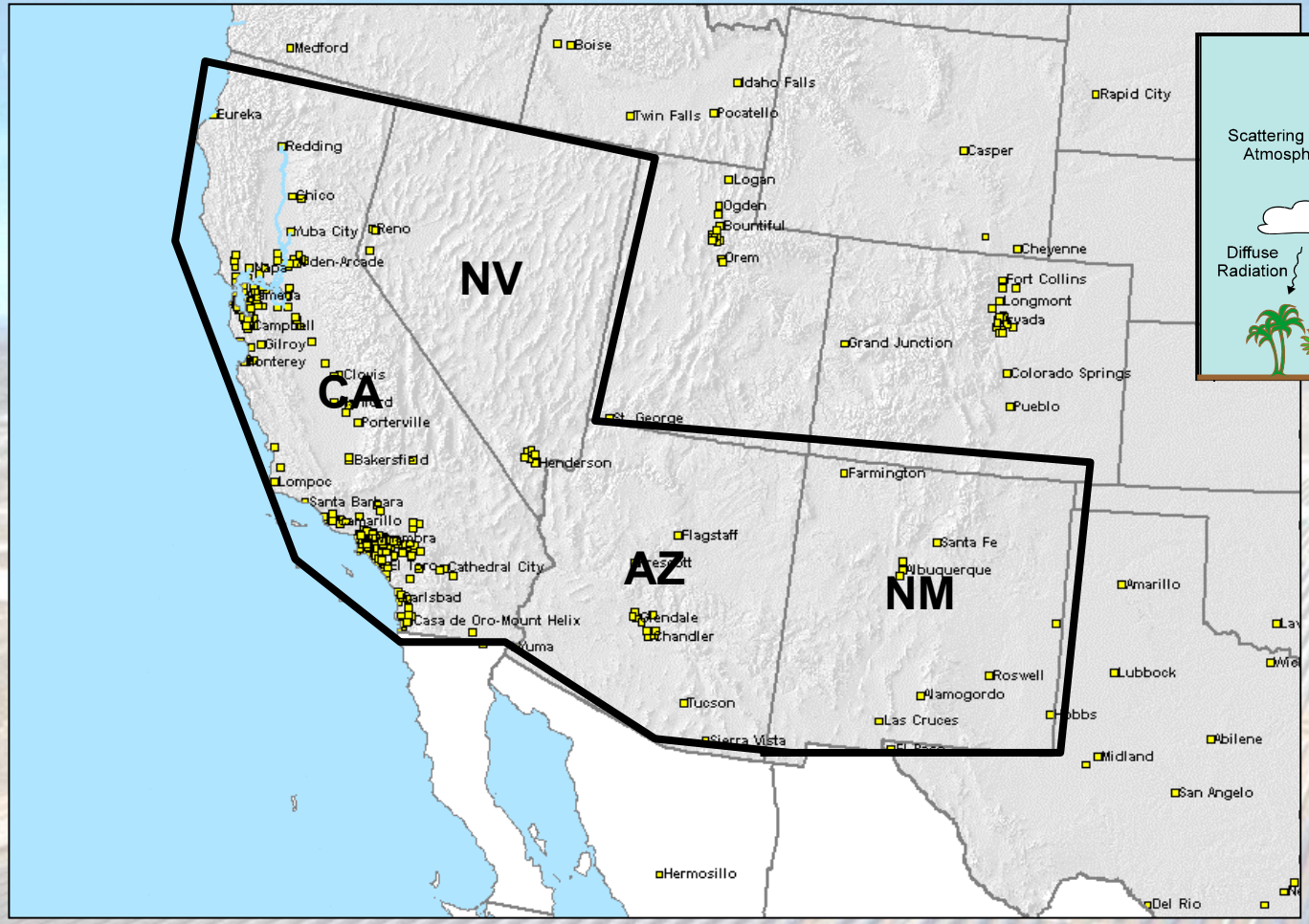
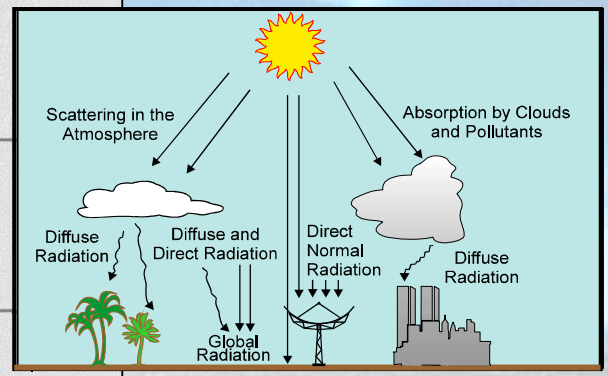
The Southwest
Four State Region

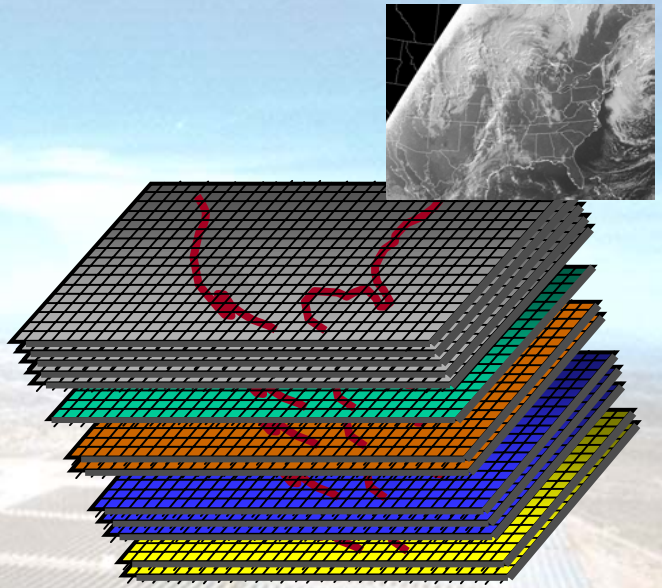




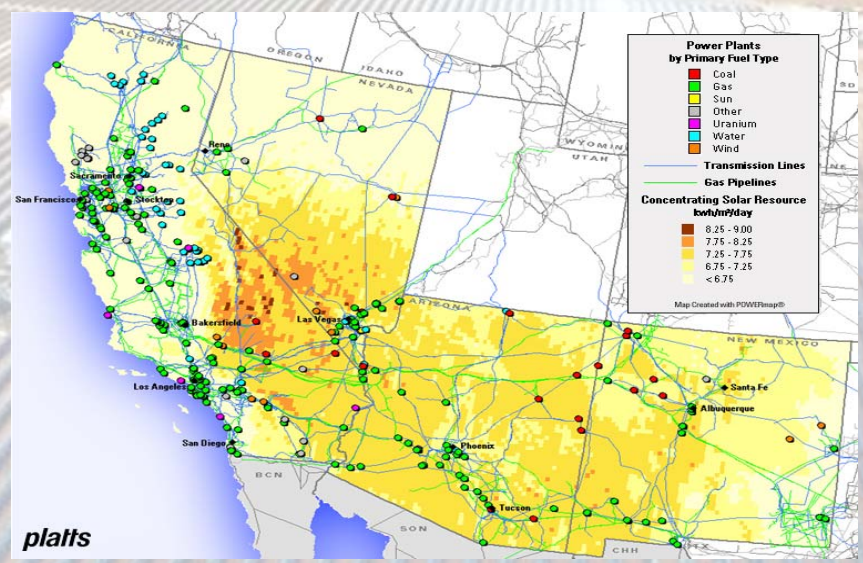
Source: Status Report on Solar Thermal Power Plants , Pilkinton Solar International, 1996..

U.S. Southwest GIS Screening Analysis

- Initial GIS screening analysis used to identify regions most economically favorable to construction of large-scale CSP systems.



- Used in conjunction w/ transmission and market analysis to identify favorable regions in four southwest states.



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Southwest Solar Resources: Which Locations Are Suitable for Development?

All Solar Resources

Locations Suitable for Development

1. Start with direct normal solar resource estimates derived from 10 km satellite data.
2. Eliminate locations with less than 6.75 kwh/m^2/day.
3. Exclude environmentally sensitive lands, major urban areas, and water features.
4. Remove land areas with greater than 1% (and 3%) average land slope
5. Eliminate areas with a minimum contiguous area of less than 10 square kilometers.

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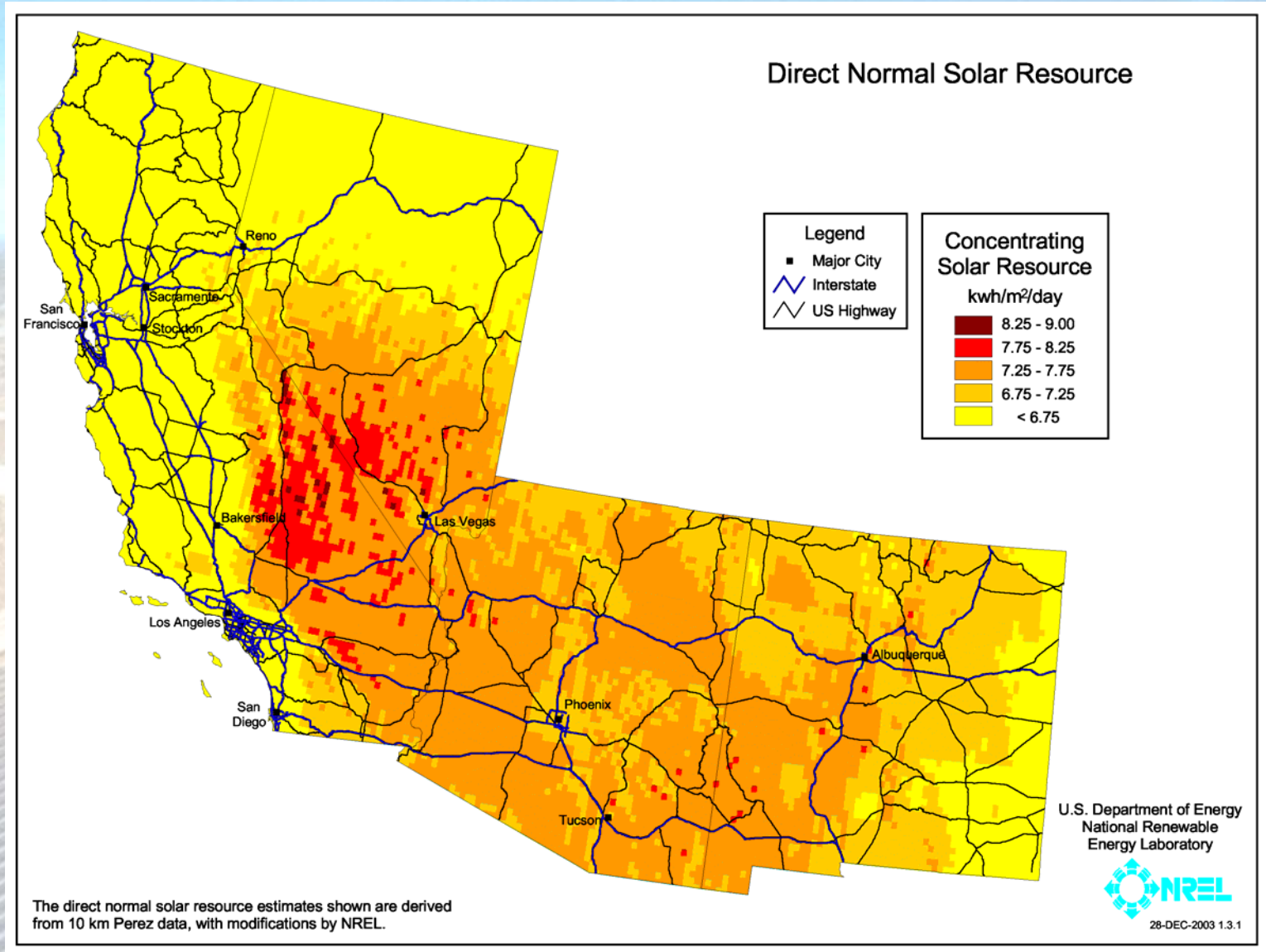
Southwest Solar Resources
Unfiltered Data



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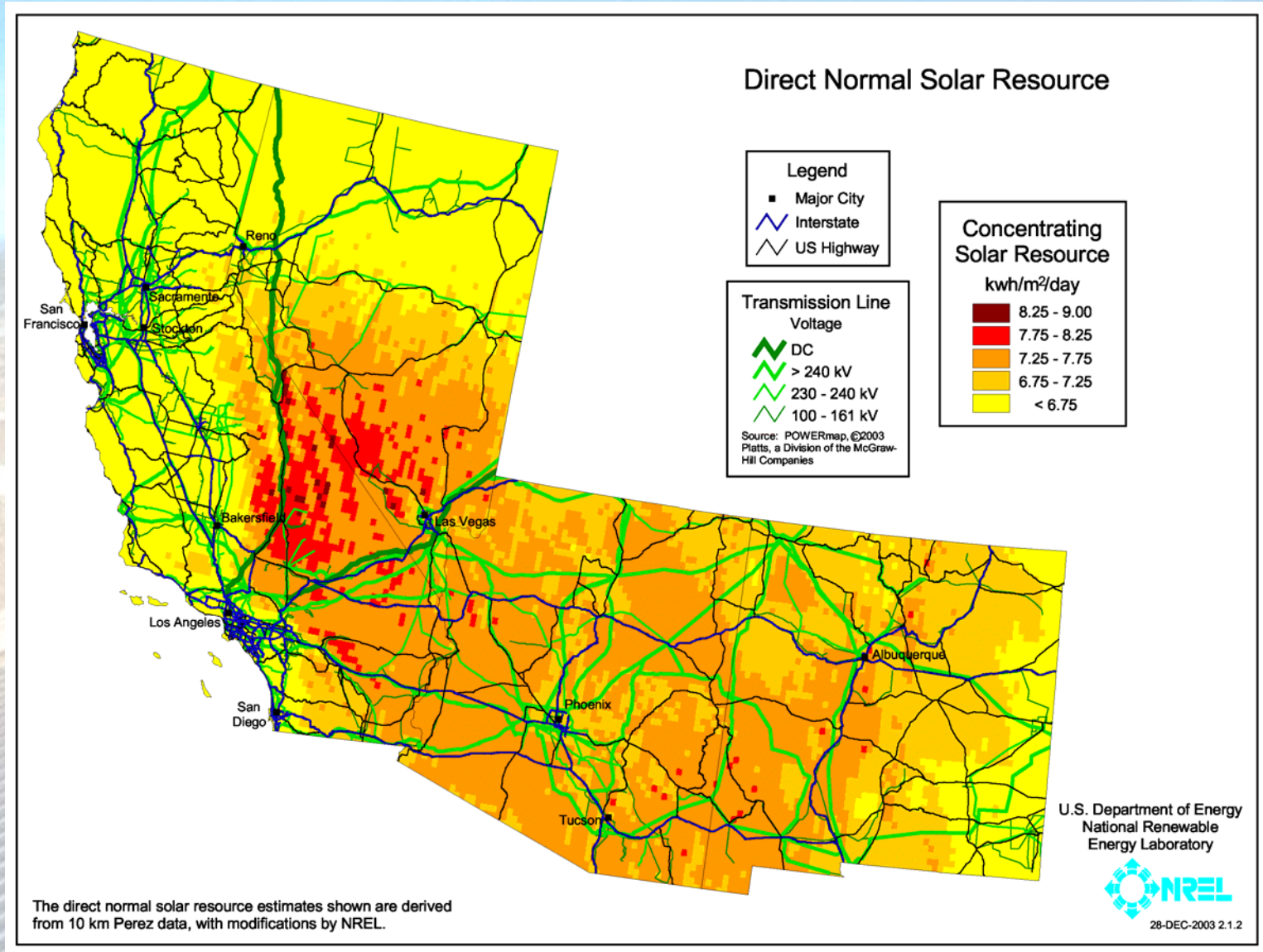
Southwest Solar Resources
Transmission Overlay



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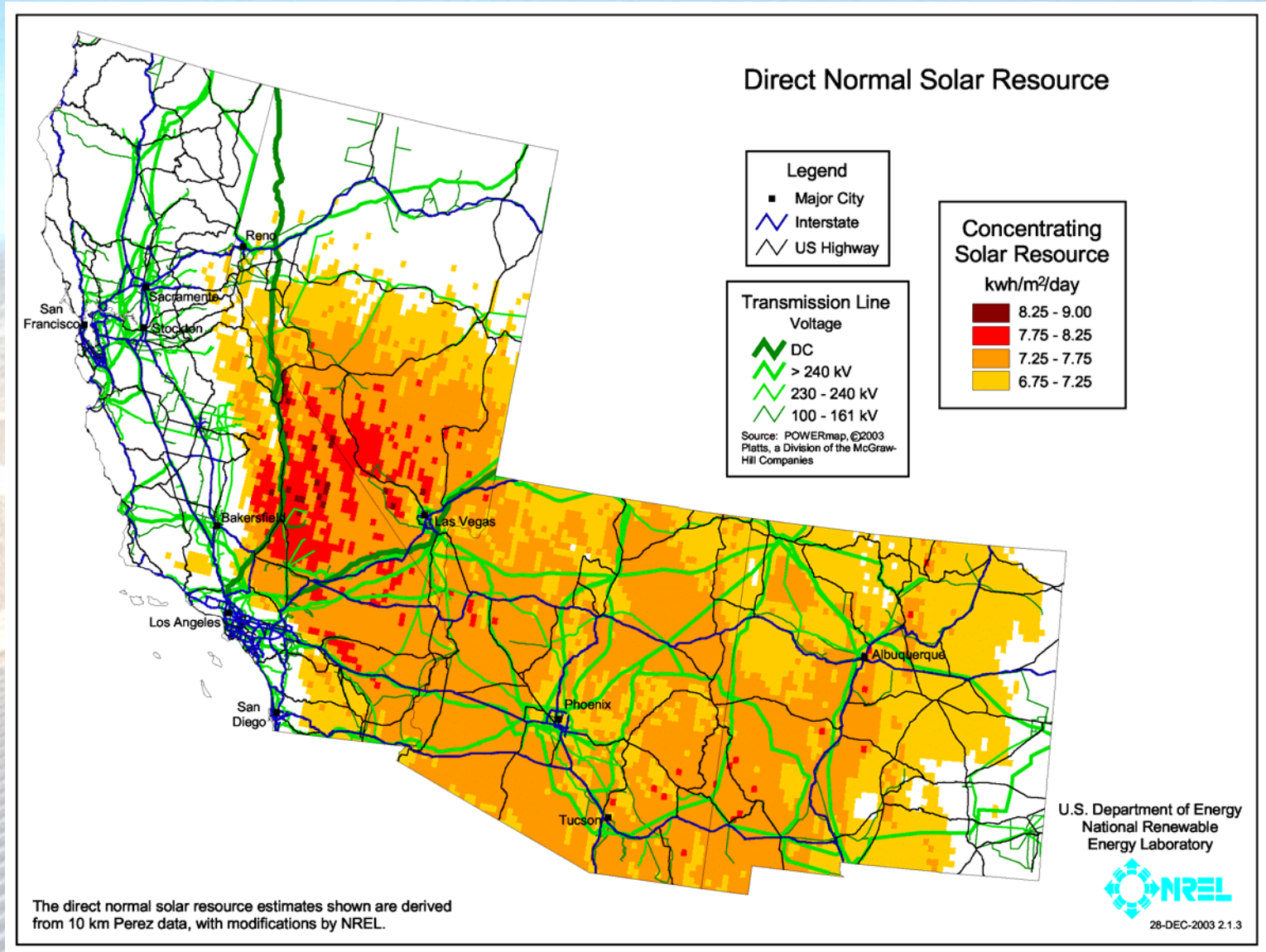
Southwest Solar Resources

Solar Resource > 6.75 kWh/m²/day



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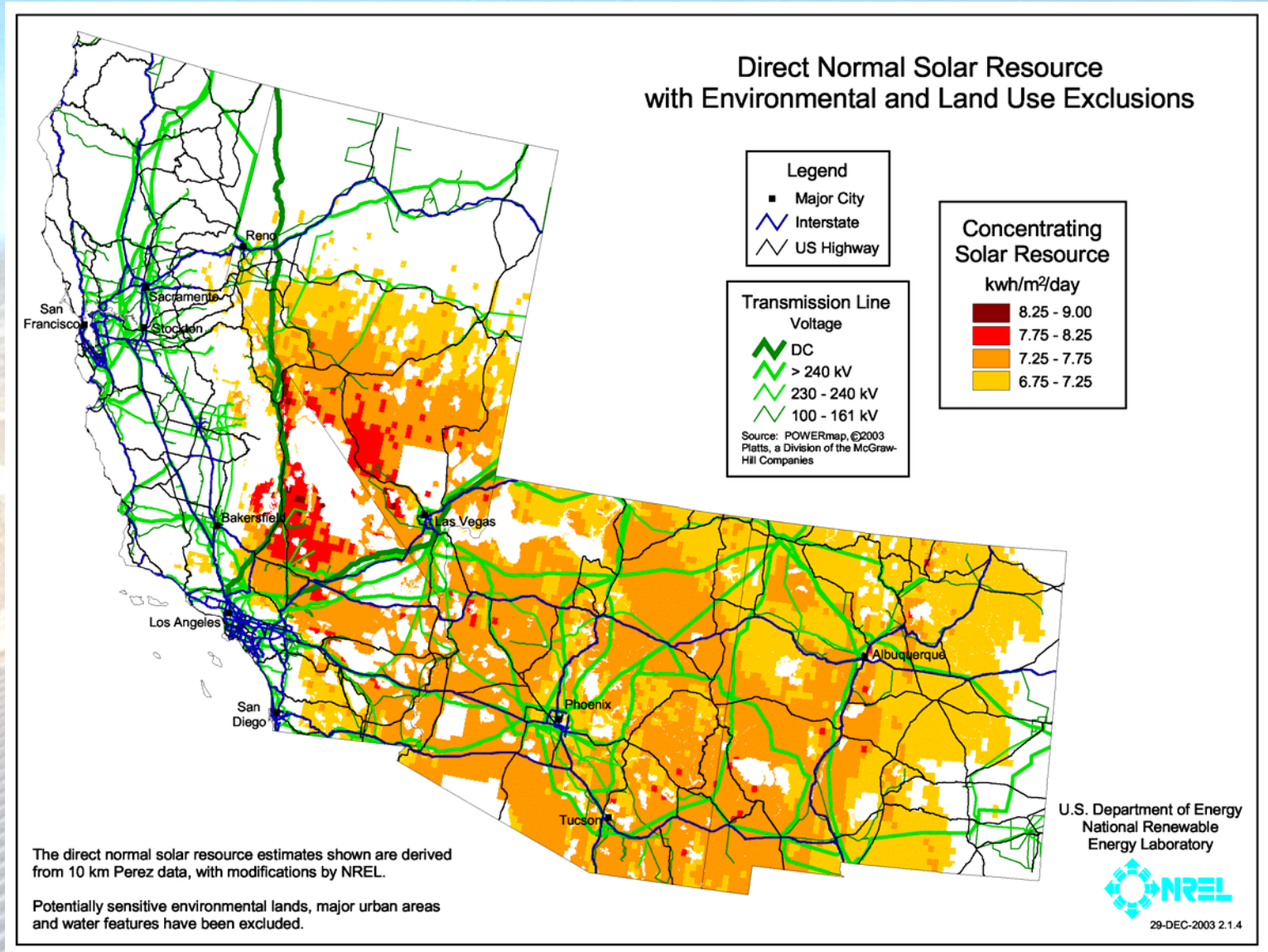
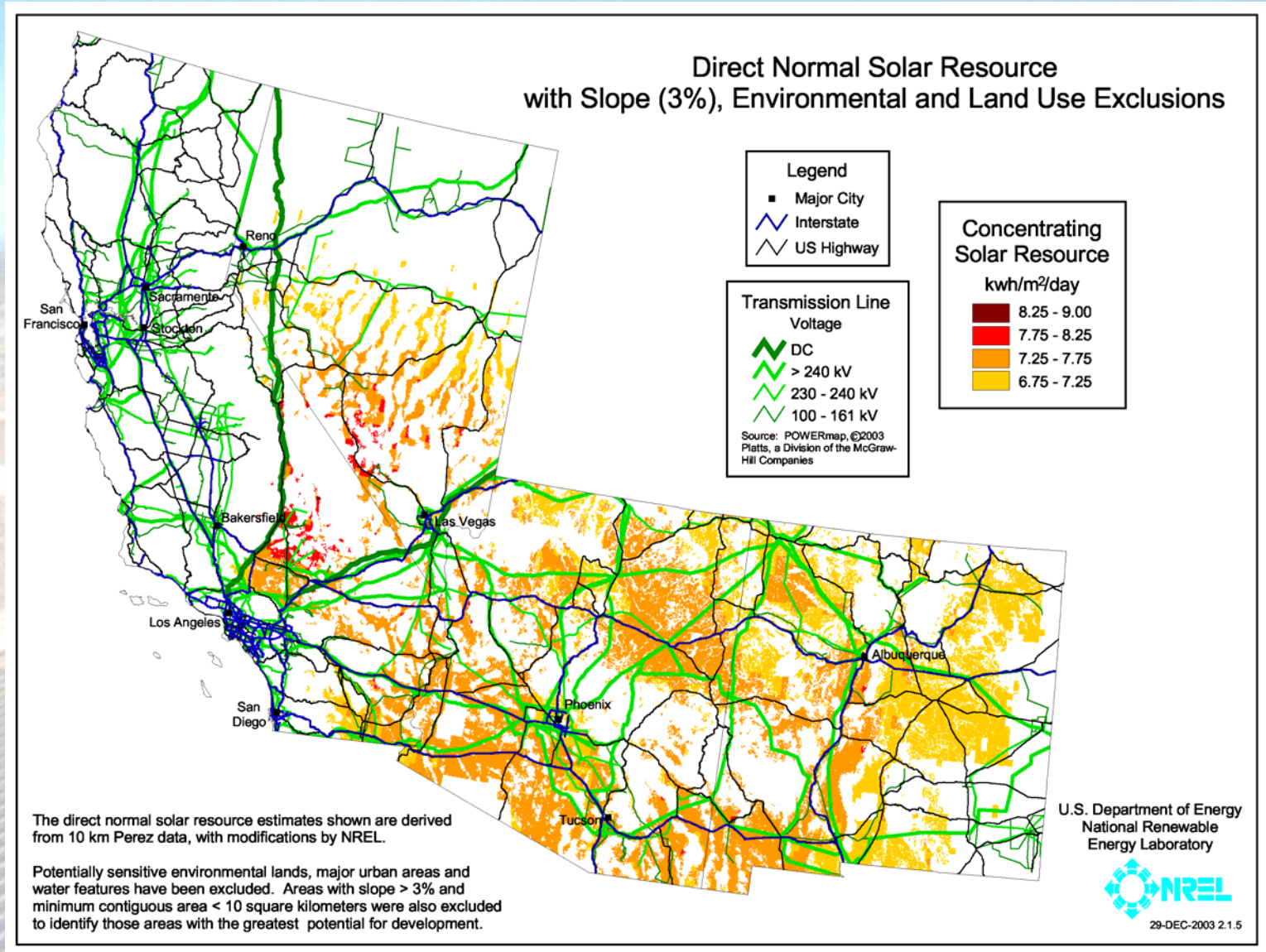
Southwest Solar Resources

Previous plus environmental & Land Use Exclusions



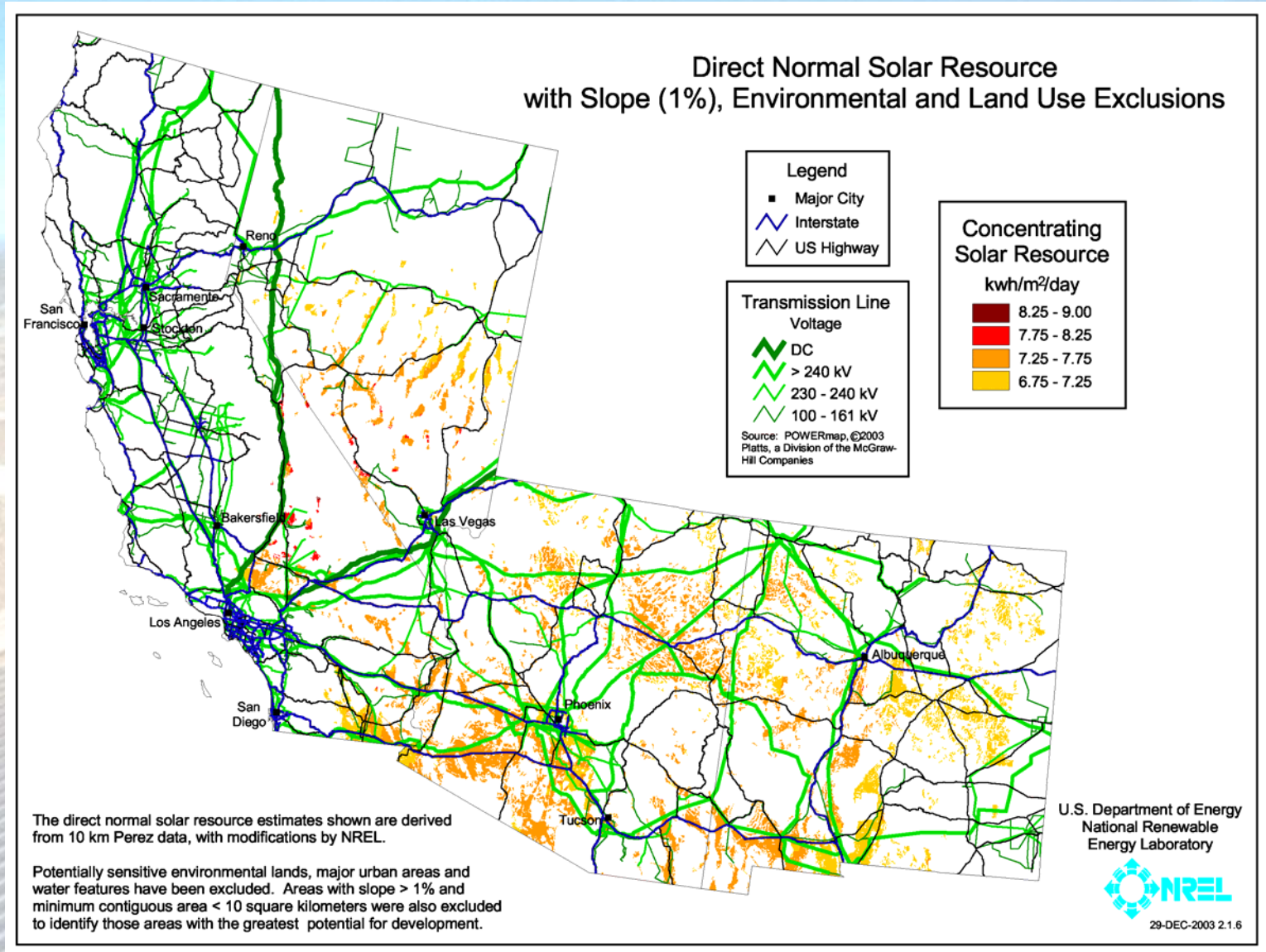
Southwest Solar Resources

Previous plus slope < 3%



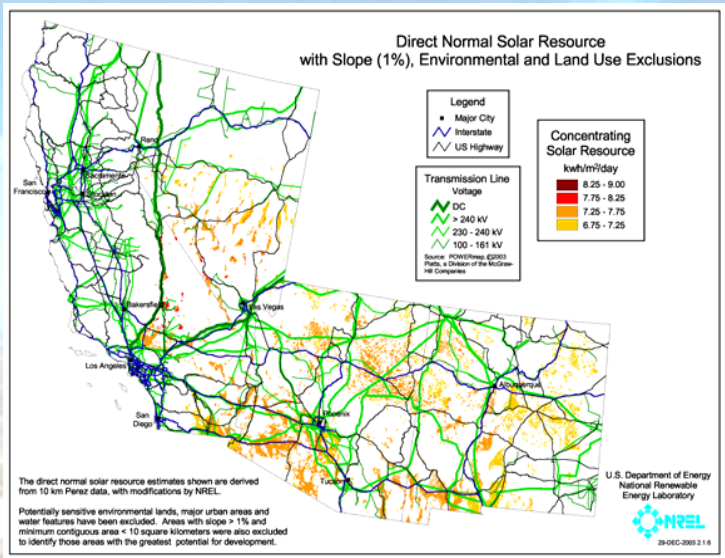
Southwest Solar Resources

Previous plus slope < 1%



Energy Benefits - SW Solar Energy Potential

State	Solar Capacity (MW)	Land Area (Sq Mi)
AZ	3,267,456	25,527
CA	821,888	6,421
NV	743,296	5,807
NM	3,025,920	23,640
Total	7,858,560	61,395



The table and map represent land that has no primary use today, exclude land with slope > 1%, and do not count sensitive lands. Solar Energy Resource ≥ 6.75

	RPS Capacity of the States				
YEAR	CA (MW)	NV (MW)	NM (MW)	AZ (MW)	Total (MW)
2008	4,343	393	129	61	4,926
2010	5,648	505	172	64	6,389
2012	5,876	627	198	68	6,769
2015	6,236	779	209	73	7,297

- **Current total generation in the four states is over 100,000 MW.**
- **Planned addition of over 35,000MW in generating capacity in the four states over the next 3 – 5 years, primarily using natural gas as fuel source.**

Southwest Market and Transmission Overview

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Southwest Market Overview

AZ, NM, NV Power Market

- These 3 states averaged population growth of 2.9 percent from 1996 to 2001. The region also had one of the highest gross state product (GSP) rates of growth in the country from 1996 to 2001. Electricity sales growth averaged 3.5%/yr. during this period.
- Arizona, New Mexico, and Nevada are expected to be three of the five fastest growing states in the country in terms of population. This growth is expected to lead to electricity sales growth of 2.3%/yr. through 2007, slowing to 1.5%/yr thereafter.
- The capacity mix has changed in recent years as gas-fired plant have been constructed. Gas and oil now surpass coal as the largest providers of capacity in the region.
- More than 24,000 MW of projects are expected to come on-line between 2002 and 2005. Of this, the majority are gas-fired combined-cycle plants. Compared to new builds, retirements in this region are minimal.
- New construction, combined with a recent slow down in population and economic growth have led to a surplus of capacity that has put downward pressure on power prices. This pressure is currently being offset to some extent by high fuel prices.

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Southwest Market Overview
California Power Market

- Population growth and a return to a more normal electricity price environment will result in strong electricity growth in California over the next several years. Electricity sales growth is projected to average 3%/yr. from 2003 to 2007. After 3007, growth is expected to remain strong at 2.6%/yr.

- California's energy mix is not like the other states in this region. With no coal-fired generation in the state and with significant renewable resources, California's fuel mix is highly diverse. Still, a significant amount of the state's capacity, roughly 58%, is oil- and gas-fired.

- The acute shortage of 2000-2001 put greater urgency on developing new capacity in California. Measures included speeding up the permitting process and securing capacity with state-guaranteed contracts. However, in spite of these measures, California still has trouble adding capacity.

- Nonetheless, approximately 6,900 MW will be added to the California market between 2003 and 2005. These conditions will create a mild surplus in the state until 2006, when a combination of announced and economic retirements is expected to drive prices higher and motivate additions of new capacity.

Southwest Market Overview

AZ, NM, NV Transmission

- The AZNMNV transmission grid consists of 500-kV, 345-kV, 230-kV, and lower voltage transmission infrastructure. Almost all of the 500-kV transmission infrastructure is in Arizona.
- Load centers are in central and southern Arizona, southern Nevada, and central New Mexico. These correspond to the metropolitan areas of Phoenix and Tucson, Arizona; Las Vegas, Nevada; and Albuquerque, Santa Fe and Las Cruces New Mexico.
- Historically the highest generating resource centers have been located at Palo Verde Arizona, northern Arizona, and the Four Corners areas resulting in predominant power flows from northeast to southwest in Arizona and from northwest to southeast in New Mexico during peak periods. The general direction of these flows is not likely to change in the foreseeable future
- Significant generating capacity is being added near Phoenix and in various locations throughout the 3 state region
- The region has substantial interconnections with California, one 230-kV connection with Utah, and connections with Colorado. Additionally, two back-to-back DC ties are located in eastern New Mexico.

Southwest Market Overview

CA Transmission

- The transmission infrastructure in California includes two high voltage DC (HVDC) lines: one connecting Los Angeles to the hydro generation in northern Oregon, and the other connecting Los Angeles to the coal generation in central Utah. But the bulk of California's infrastructure is operated at 500-kV and 230-kV.
- In general, during peak summer conditions, power flows into California from Arizona and Nevada, but during the winter the flows typically shift from California to the Pacific Northwest. Path 15 is the most binding constraint in the south-to-north
- Power flows from the Four Corners region through Arizona, and power delivered from Palo Verde and other gas-fired generations in Arizona, create a significant bottleneck running along the California-Arizona border
- Power flowing through Las Vegas in route to Southern California, and power flowing between Northern Nevada and North California has resulted in a bi-direction east-to-west transmission bottleneck along the California-Nevada border.

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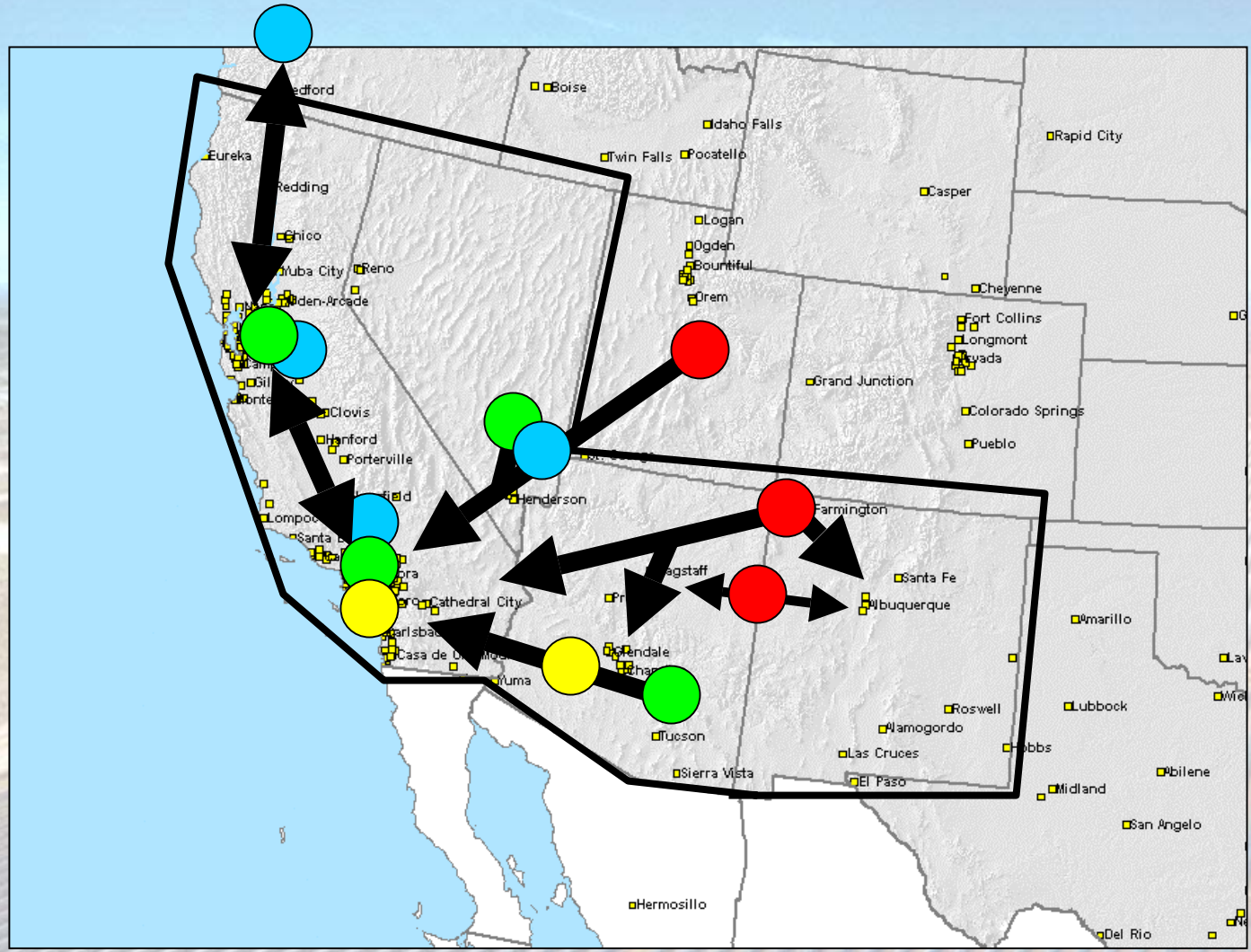
Southwest Market Overview
Generation & Transmission



Generation

- Hydro
- Coal
- Nuclear
- Gas

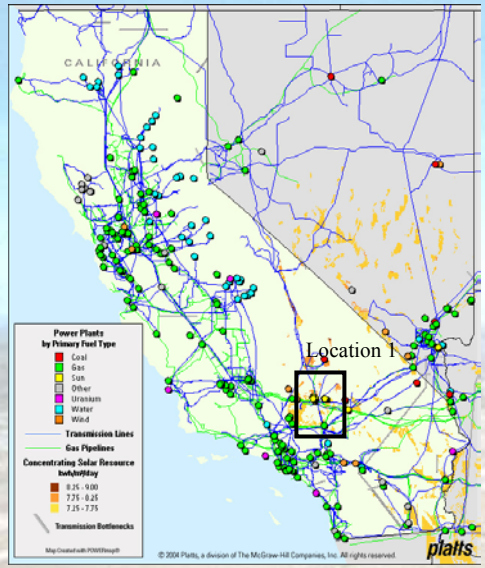
Transmission

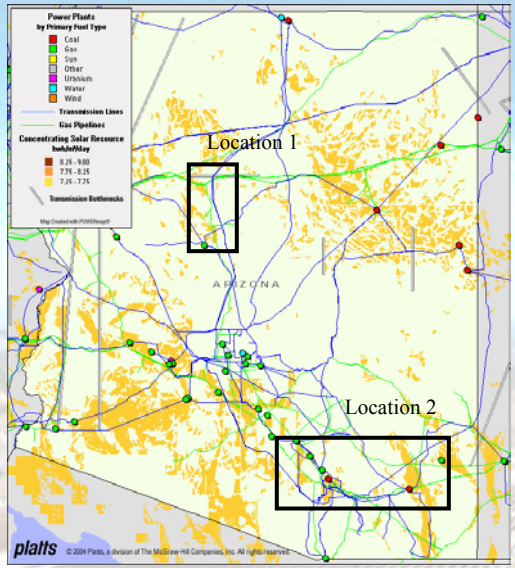
- Power Flows
- Direction of Flow

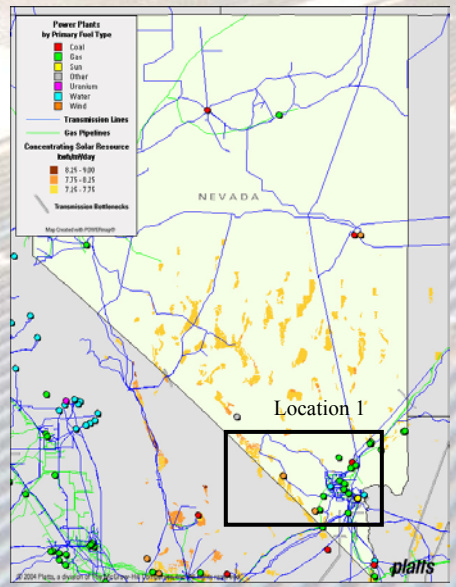
Southwest Market Overview
Summary

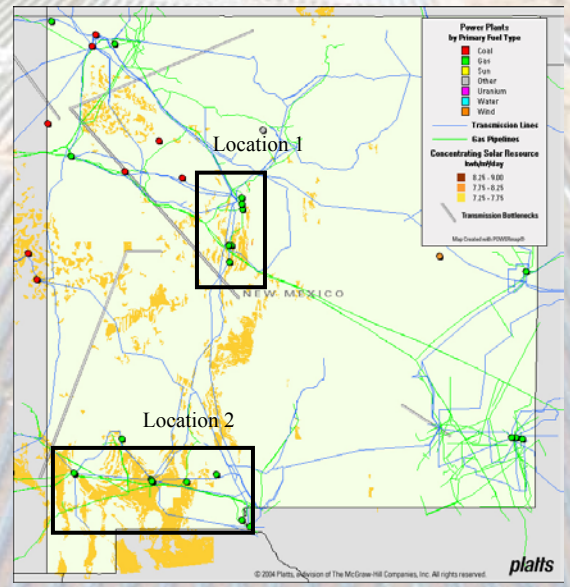
- The region is generally well stocked with diversified generation sources including coal, gas, nuclear, and renewables.
- The region is also electricity well-connected with significant power flows running bi-directionally from both east-to-west and north-to-south.
- These flows create significant bottlenecks throughout the region.
- These bottlenecks may limit the level of new generation capacity that can be sited outside of major population centers.

4-State Resource/GIS Analysis

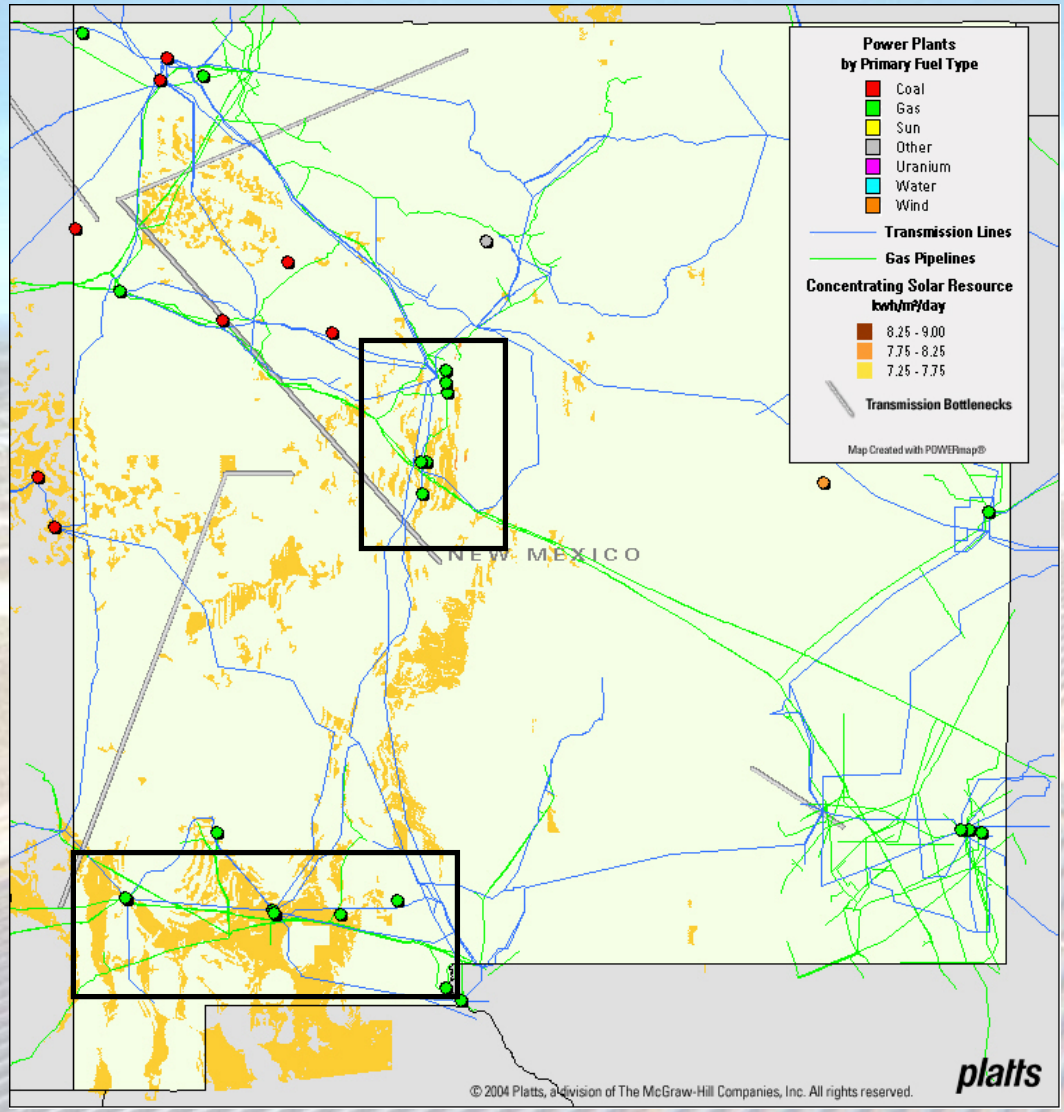


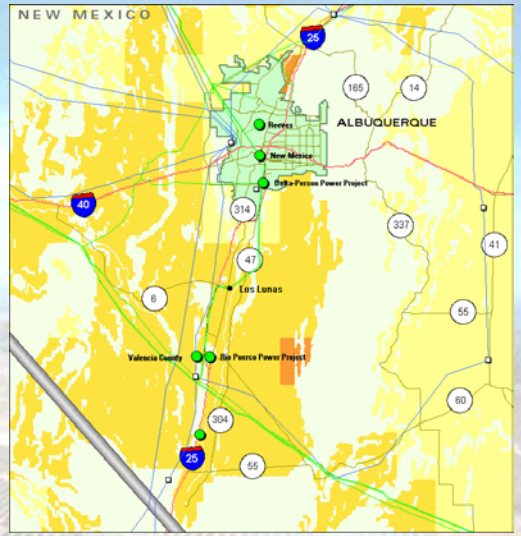


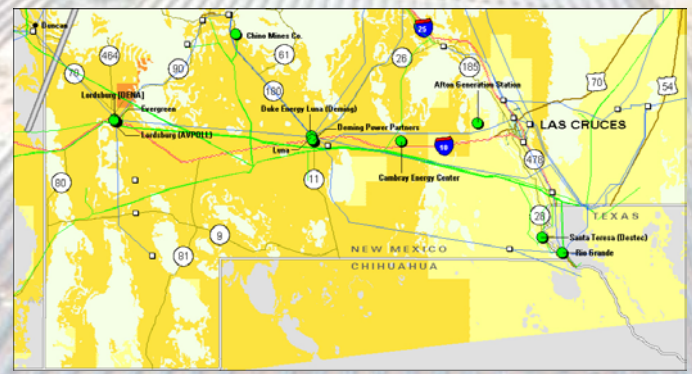




New Mexico Proposed Regions







Siting Analysis Next Steps

- To fully identify favorable solar power plant siting opportunities, additional factors such as land ownership, road access, and local transmission infrastructure capabilities and loadings must be examined in detail.
- This will involve discussion with local experts, utility specialists and may include visits to prospective locations.
- State-level policies and regulatory frameworks must be assessed to determine the favorability of CSP development in a particular state.
- If necessary, the impact of solar resources on the transmission system can be fully considered through the construction of security-constrained load flow model scenarios.
- More detailed siting analysis underway for the state of New Mexico where Governor Richardson has announced his intent to begin construction of a 50MW or larger CSP plant by the end of 2005.

New Mexico Solar Task Force

- Governor Richardson of New Mexico, at Western Governors' Energy Summit, announced formation a of NM solar task force
  - Goal of task force is to identify opportunity site(s) and recommend policies/incentives necessary to begin construction of a 50MW or larger plant by the end of 2005.
  - Competitive solicitation for a "New Mexico Concentrating Solar Power Feasibility Study" issued in June. The State of New Mexico has selected Black and Veatch to lead four month effort.
  - Effort includes technology assessment, detailed NM siting analysis, Federal/State policy analysis, state/regional market analysis, financing/incentives analysis, and NM economic impact analysis.

Summary

- A preliminary resource, market, and siting analysis has been completed for the southwest U.S.
- Results from the analysis have been presented to energy and economic staff in the states of New Mexico, Nevada, Arizona, and California.
- Significant solar resources are available to service local loads and to meet state renewable portfolio requirements, especially where added incentives are given to solar.
- More detailed siting analysis underway for the state of New Mexico where Governor Richardson has announced his intent to begin construction of a 50MW or larger CSP plant by the end of 2005.